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# Designing Hybrid Graph Model and Algorithmic Analysis of Workflow Decomposition in Mobile Distributed Systems

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**Abstract**

The execution of data intensive workflow is challenging in the domain of mobile distributed systems due to the involvement of heterogeneous computing devices and dynamic network topology. Moreover, data intensive workflow execution requires frequent access to database servers for dataflow and control flow operations resulting in massive data transfer. The workflow decomposition and distribution are required to minimize data transfer and to reduce execution delay in mobile distributed systems. This paper proposes a hybrid graph model of workflow in mobile distributed systems relying on dynamic network topology and distributed database in order to facilitate workflow decomposition. The algebraic and numerical analysis of the hybrid graph model is represented providing inherent properties. Furthermore, we have presented an extensive analytical study of existing workflow decomposition approaches and have provided detailed analysis to determine the suitability of these approaches in mobile distributed systems. We have also proposed a novel framework and implementation directions for workflow decomposition based on multiple parameters for mobile distributed systems.

**Keywords:** Workflow decomposition, distributed database, workflow graph, algorithmic analysis, mobile distributed systems, adjacency matrices.

## 1. Introduction

A mobile distributed system is consisting of heterogeneous resources and computing nodes having mobility [8]. In such systems, the network topology is dynamic, the nodes are unreliable and, communication may fail due to network disconnection due to low bandwidth of wireless networks [1]. The handheld mobile devices impose resource constraints in terms of computing capability, storage space and, energy. Moreover, unpredictable mobility of nodes in mobile distributed systems creates further challenges. Thus, designing and implementing data intensive workflows in mobile distributed systems are difficult to execute due to frequent access to database server to query, store and manage dataflow operations [2, 3]. Furthermore, inefficient task assignments to nodes and mobility of nodes cause unexpected delay in data intensive workflow execution in mobile distributed systems. Hence, it is desirable to decompose large scale workflows into sub-workflows as well as careful deployment of distributed datasets across multiple execution sites. In general, the decomposition of large scale workflows in mobile distributed systems requires consideration of the workflow structural properties as well as computational capacity and mobility of the underlying network resources [4]. The primary objective of workflow decomposition and its distributed execution is to minimize the possibility of single point of resource contention and reduce data movement between partitioned workflows [39]. Thus, workflow decomposition and careful placement of associated datasets can significantly improve the overall performance. Moreover, in mobile distributed systems optimal workflow decomposition of data intensive applications is essential for efficient task assignment and better resources utilization. It is